VERIFICATION OF TRANSLATION

I, Shunichi Higuchi, of 12-7, Aza Fujigaoka, Oaza Fujie, Higashiura-cho, Chita-gun, Aichi 470-2105 Japan, hereby declare that I am conversant with the English and Japanese languages and that I am the translator of the document attached and certify that to the best of my knowledge and belief the following is a true and correct English translation of Japanese Patent Application No. 2003-11489.

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[Document name] Description

[Title of the invention] Occupant protection device

[Claims]

[Claim 1] An occupant protection device comprising an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar, the airbag having substantially the same vertical dimension as that of a seat back, wherein the airbag has a first region that is thinner than other regions in a vehicle width direction in the inflated state, the first region being disposed substantially at the center of the airbag in the vertical direction and extending substantially parallel to the seat back.

[Claim 2] The occupant protection device according to Claim 1, wherein the airbag also has a second region that is thin in the vehicle width direction in the inflated state, the second region being disposed in front of and above the first region at a position corresponding to the upper arm of the occupant.

[Claim 3] The occupant protection device according to Claim 1, wherein the first region that is thin in the vehicle width direction in the inflated state is substantially oval in side view.

[Claim 4] The occupant protection device according to one of Claims 1 to 3, wherein the first region that is thin in the vehicle width direction in the inflated state is divided into sections in the vertical direction, and wherein a gas passage is provided between the sections.

[Claim 5] An occupant protection device comprising an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar and gas-pressure controlling means for setting an inner pressure of at least one of an upper

portion and a lower portion of the airbag higher than an inner pressure of the remaining portion.

[Claim 6] The occupant protection device according to Claim 5, wherein the upper portion or the lower portion of the airbag is thicker than the remaining portion in the vehicle width direction in the inflated state.

[Claim 7] An occupant protection device comprising an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar and inflation controlling means for inflating at least one of an upper portion and a lower portion of the airbag before the remaining portion.

[Claim 8] The occupant protection device according to Claim 7, wherein the remaining portion extends substantially parallel to a seat back.

[Claim 9] The occupant protection device according to one of Claims 7 and 8, wherein the inflation controlling means is gas-flow regulating means for causing the gas to flow into the upper portion or the lower portion of the airbag before flowing into the remaining portion, the gas-flow regulating means being formed in the airbag by sewing.

[Claim 10] An occupant protection device comprising an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar, wherein the airbag includes shape adjusting means for adjusting the shape of the airbag so that the side of the airbag facing the occupant extends along the side of the occupant in the inflated state.

[Claim 11] The occupant protection device according to Claim 10, wherein the shape adjusting means is one or more straps that extend in the vehicle width direction in the airbag.

[Claim 12] The occupant protection device according to one of Claims 1 to 11, wherein the airbag includes an inflatable body at the bottom of the airbag, the inflatable body being inflated at the side of the thigh of the occupant.

[Claim 13] The occupant protection device according to one of Claims 1 to 12, wherein the airbag is folded such that an upper portion and a lower portion are placed on a center portion and is then rolled or accordion-folded in a front-to-rear direction of the vehicle.

[Claim 14] An occupant protection device comprising an airbag attached to a seat of a vehicle, the airbag being inflated with gas from an inflator to protect the body of an occupant, wherein the airbag moves the chest of the occupant away from a projecting portion of the vehicle when the vehicle collides on one side.

[Claim 15] The occupant protection device according to Claim 14, wherein the airbag moves the chest of the occupant diagonally to the front away from a door of the vehicle.

[Claim 16] The occupant protection device according to Claim 15, wherein the airbag includes a first inflatable body that inflates between a seat back and the back of the occupant along the edge adjacent to the door and a second inflatable body that inflates between the door and the side of the occupant adjacent to the door.

[Detailed explanation of the invention]

[0001]

[Technical Field of the invention]

The present invention relates to an occupant protection device including an airbag for protecting an occupant by being inflated with gas

supplied from an inflator when, for example, a side collision or the like of a vehicle occurs.

[0002]

[Prior art]

This type of occupant protection device is described in, for example, Patent document 1 below. This document discloses an occupant protection device including an airbag (side airbag) disposed such that the airbag can be inflated at the side of an occupant which is adjacent to a door. When a side collision or the like of a vehicle occurs, the airbag is inflated with gas supplied from an inflator in order to protect the head and torso of the occupant.

[0003]

[Patent document 1]

Japanese Unexamined Patent Application Publication No. 2000-289556

[0004]

[Problem to be resolved by the invention]

In the occupant protection device according to the above-mentioned publication, when a side collision of the vehicle occurs, the airbag protects the head and torso of the occupant. However, the occupant protection device according to the above-mentioned publication does not aim to protect the torso of the occupant, in particular the chest and abdomen of the occupant. Accordingly, there is a risk that a large load will be applied to the chest and abdomen of the occupant, and there is a room for improvement. Therefore, an object of the present invention is to prevent the chest and abdomen of an occupant from receiving a large load when a side collision or the like of a vehicle occurs.

[0005]

[Means to solve the problem]

A feature of the present invention (invention according to Claim 1) is that an occupant protection device includes an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar, the airbag having substantially the same vertical dimension as that of a seat back and having a first region that is thinner than other regions in a vehicle width direction in the inflated state, the first region being disposed substantially at the center of the airbag in the vertical direction and extending substantially parallel to the seat back.

[0006]

In this case, it is preferable (invention according to Claim 2) that the airbag also has a second region that is thin in the vehicle width direction in the inflated state, the second region being disposed in front of and above the first region at a position corresponding to the upper arm of the occupant. It is preferable (invention according to Claim 3) that the first region, which is thin in the vehicle width direction in the inflated state, is substantially oval in side view. In these cases, it is preferable (invention according to Claim 4) is that the first region, which is thin in the vehicle width direction in the inflated state, is divided into sections in the vertical direction, and a gas passage is provided between the sections.

[0007]

A feature of the present invention (invention according to Claim 5) is that an occupant protection device includes an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar and gas-pressure controlling

means for setting an inner pressure of at least one of an upper portion and a lower portion of the airbag higher than an inner pressure of the remaining portion. In this case, it is preferable (invention according to Claim 6) that the upper portion or the lower portion of the airbag is thicker than the remaining portion in the vehicle width direction in the inflated state.

[0008]

A feature of the present invention (invention according to Claim 7) is that an occupant protection device includes an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar and inflation controlling means for inflating at least one of an upper portion and a lower portion of the airbag before the remaining portion.

[0009]

In this case, it is preferable (invention according to Claim 8) that the remaining portion extends substantially parallel to a seat back. it is preferable (invention according to Claim 9) that the inflation controlling means is gas-flow regulating means for causing the gas to flow into the upper portion or the lower portion of the airbag before flowing into the remaining portion, the gas-flow regulating means being formed in the airbag by sewing.

[0010]

A feature of the present invention (invention according to Claim 10) is that an occupant protection device includes an airbag that is inflated with gas from an inflator at a side of an occupant to protect the body of the occupant from the shoulder to the lumbar, wherein the airbag includes shape adjusting means for adjusting the shape of the airbag so that the side

of the airbag facing the occupant extends along the side of the occupant in the inflated state. In this case, it is preferable (invention according to Claim 11) that the shape adjusting means is one or more straps that extend in the vehicle width direction in the airbag.

[0011]

In each of the above cases, it is preferable (invention according to Claim 12) that the airbag includes an inflatable body at the bottom of the airbag, the inflatable body being inflated at the side of the thigh of the occupant. It is preferable (invention according to Claim 13) that the airbag is folded such that an upper portion and a lower portion are placed on a center portion and is then rolled or accordion-folded in a front-to-rear direction of the vehicle.

[0012]

A feature of the present invention (invention according to Claim 14) is that an occupant protection device includes an airbag attached to a seat of a vehicle, the airbag being inflated with gas from an inflator to protect the body of an occupant, wherein the airbag moves the chest of the occupant away from a projecting portion of the vehicle when the vehicle collides on one side. In this case, it is preferable (invention according to Claim 15) that the airbag moves the chest of the occupant diagonally to the front away from a door of the vehicle. It is preferable (invention according to Claim 16) that the airbag includes a first inflatable body that inflates between a seat back and the back of the occupant along the edge adjacent to the door and a second inflatable body that inflates between the door and the side of the occupant adjacent to the door.

[0013]

[Action and effect of the invention]

In the occupant protection apparatus according to the present invention (invention according to Claim 1), when a side collision or the like of the vehicle occurs, the airbag is inflated with the gas from the inflator at the side of the occupant and is placed between the vehicle body and the body of the occupant from the shoulder to the lumbar. Therefore, if a part of the vehicle body enters the vehicle cabin, the occupant is pushed by the airbag toward the center of the vehicle cabin in the vehicle width direction, and the body of the occupant from the shoulder to the lumbar is protected.

[0014]

In this occupant protection device, the region which is thinner than other regions in the vehicle width direction in the inflated state is formed substantially at the center of the airbag in the vertical direction. Accordingly, when the occupant is pushed by the airbag toward the center of the vehicle cabin in the vehicle width direction, although the shoulder and the lumbar, which come into contact with the upper and lower portions, respectively, receive a large load, the chest and the abdomen, which come into contact with a substantially central portion of the airbag in the vertical direction, do not receive a large load. Therefore, when a side collision or the like of the vehicle occurs, the occupant is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest and the abdomen.

[0015]

In addition, in this occupant protection device, the first region of the airbag which is thin in the vehicle width direction in the inflated state is formed substantially at the center of the airbag in the vertical direction and

extends substantially parallel to the seat back. Therefore, the first region can be positioned along the side of the occupant from the chest to the abdomen, and the load applied to the chest and the abdomen of the occupant when a side collision or the like of the vehicle occurs is reliably reduced.

[0016]

In the occupant protection apparatus according to the present invention (invention according to Claim 2), the airbag also has the second region that is thin in the vehicle width direction in the inflated state, the second region being disposed in front of and above the first region at a position corresponding to the upper arm of the occupant. Therefore, when a side collision or the like of the vehicle occurs, the occupant is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest, the abdomen, and the upper arm.

[0017]

In the occupant protection apparatus according to the present invention (invention according to Claim 3), the first region that is thin in the vehicle width direction in the inflated state is substantially oval in side view. Therefore, even when the occupant sits at different positions in the front-back direction, the first region can be positioned along the side of the occupant from the chest to the abdomen. Accordingly, the load applied to the chest and the abdomen of the occupant when a side collision or the like of the vehicle occurs is reliably reduced.

[0018]

In the occupant protection apparatus according to the present invention (invention according to Claim 4), the first region that is thin in the

vehicle width direction in the inflated state is divided into sections in the vertical direction, and wherein the gas passage is provided between the sections. Therefore, when a side collision or the like of the vehicle occurs, the gas supplied from the inflator quickly flows in the front-rear direction of the vehicle through the gas passage in the airbag. Accordingly, the airbag is quickly inflated in the front-rear direction of the vehicle, and the airbag is quickly placed between the occupant and the vehicle body.

[0019]

In the occupant protection apparatus according to the present invention (invention according to Claim 5), the occupant protection device comprises the gas-pressure controlling means for setting an inner pressure of at least one of an upper portion and a lower portion of the airbag higher than an inner pressure of the remaining portion. Therefore, when a side collision or the like of the vehicle occurs, the shoulder or the lumbar of the occupant, which comes into contact with the upper or lower portion of the inflated airbag, is quickly moved by being pushed with a large gas pressure. Accordingly, when a side collision or the like of the vehicle occurs, the occupant is quickly pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest and the abdomen.

[0020]

In the occupant protection apparatus according to the present invention (invention according to Claim 6), the upper portion or the lower portion of the airbag is thicker than the remaining portion in the vehicle width direction in the inflated state. Therefore, when a side collision or the like of the vehicle occurs, the shoulder or the lumbar of the occupant, which comes

into contact with the upper or lower portion of the inflated airbag, is largely moved. Accordingly, when a side collision or the like of the vehicle occurs, the occupant is largely moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest and the abdomen.

[0021]

In the occupant protection apparatus according to the present invention (invention according to Claim 7), the occupant protection device comprises the inflation controlling means for inflating at least one of an upper portion and a lower portion of the airbag before the remaining portion. Therefore, when a side collision or the like of the vehicle occurs, the shoulder or the lumbar of the occupant, which comes into contact with the upper or lower portion of the inflated airbag, is pushed before the chest and the abdomen of the occupant. Therefore, when a side collision or the like of the vehicle occurs, the occupant is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest and the abdomen.

[0022]

In the occupant protection apparatus according to the present invention (invention according to Claim 8), the remaining portion that is inflated after the upper or lower portion of the airbag extends substantially parallel to a seat back. Therefore, the remaining portion that is inflated after the upper or lower portion of the airbag can be positioned along the side of the occupant from the chest to the abdomen. Accordingly, and the load applied to the chest and the abdomen of the occupant when a side collision or the like of the vehicle occurs is reliably reduced.

[0023]

In the occupant protection apparatus according to the present invention (invention according to Claim 9), the inflation controlling means is the gas-flow regulating means for causing the gas to flow into the upper portion or the lower portion of the airbag before flowing into the remaining portion, the gas-flow regulating means being formed in the airbag by sewing. Therefore, the inflation controlling means is easily formed.

[0024]

In the occupant protection apparatus according to the present invention (invention according to Claim 10), the airbag that is inflated at a side of an occupant includes shape adjusting means for adjusting the shape of the airbag so that the side of the airbag facing the occupant extends along the side of the occupant in the inflated state. Therefore, the occupant is prevented from receiving a local load from the inflated airbag. Accordingly, not only the load applied to the shoulder and the lumbar of the occupant when a side collision or the like of the vehicle occurs but also the load applied to the chest and the abdomen of the occupant is reliably reduced.

[0025]

In the occupant protection apparatus according to the present invention (invention according to Claim 11), the shape adjusting means included in the airbag that inflates at the side of the occupant is one or more straps that extend in the vehicle width direction in the airbag. Therefore, the shape adjusting means is easily formed.

[0026]

In the occupant protection apparatus according to the present invention (invention according to Claim 12), the airbag that inflates at the

side of the occupant includes the inflatable body at the bottom of the airbag, the inflatable body being inflated at the side of the thigh of the occupant. Therefore, the thigh of the occupant is also pushed by the inflated airbag when a side collision or the like of the vehicle occurs. Therefore, when a side collision or the like of the vehicle occurs, the occupant is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest and the abdomen.

[0027]

In the occupant protection apparatus according to the present invention (invention according to Claim 13), the airbag that inflates at the side of the occupant is folded such that an upper portion and a lower portion are placed on a center portion and is then rolled or accordion-folded in a front-to-rear direction of the vehicle. Therefore, when a side collision or the like of the vehicle occurs, the airbag is first inflated in the front-rear direction of the vehicle, and then in the vertical direction. Therefore, although the airbag is attached to the seat back or a door portion corresponding thereto in the folded and rolled state, the airbag is quickly and reliably inflated in the space between the occupant and the vehicle body when a side collision or the like of the vehicle occurs.

[0028]

In the occupant protection apparatus according to the present invention (invention according to Claim 14), the airbag attached to a seat of a vehicle, is inflated with gas from an inflator when a side collision or the like of the vehicle occurs, and moves the chest of the occupant away from a projecting portion of the vehicle when the vehicle collides on one side. Therefore, when a side collision or the like of the vehicle occurs, the chest

of the occupant is prevented from encountering the projecting portion of the vehicle, and the load applied to the chest of the occupant is reduced.

[0029]

In the occupant protection apparatus according to the present invention (invention according to Claim 15), the airbag, which is attached to the seat and is inflated when a side collision or the like of the vehicle occurs, moves the chest of the occupant diagonally to the front away from the door of the vehicle. Therefore, the chest of the occupant is reliably prevented from encountering the armrest provided on the vehicle door, and the load applied to the chest of the occupant is reduced.

[0030]

In the occupant protection apparatus according to the present invention (invention according to Claim 16), the airbag, which is attached to the seat and is inflated with the gas from the inflator when a side collision or the like of the vehicle occurs, includes the first inflatable body that inflates between a seat back and the back of the occupant along the edge adjacent to the door and the second inflatable body that inflates between the door and the side of the occupant adjacent to the door. Therefore, when a side collision or the like of the vehicle occurs, the first and second inflatable bodies of the airbag reliably move the chest of the occupant diagonally to the front away from the door. In addition, the second inflatable body of the airbag serves to reduce the load applied to the occupant from the door.

[0031]

[Embodiment for Carrying Out the Invention]

Embodiments of the present invention will be described below with reference to the drawings. Figs. 1 to 3 schematically illustrate an occupant

protection device according to a first embodiment of the present invention. The occupant protection device according to the first embodiment is attached to a seat back Aa included in a seat A of a vehicle and includes an airbag 10 disposed such that the airbag 10 can be inflated at the side of an occupant B which is adjacent to a door and an inflator 20 that supplies gas to the airbag 10.

[0032]

When a side collision or the like of the vehicle occurs, the airbag 10 is inflated at the side of the occupant B adjacent to the door with gas supplied from the inflator 20, as shown in Figs. 1 and 2. Thus, the airbag 10 protects the body of the occupant B from the shoulder Ba to the lumbar Bd. The vertical dimension of the airbag 10 is substantially the same as that of the seat back Aa. The airbag 10 is formed in a bag-like shape by folding an airbag material with a predetermined shape in half and airtightly bonding a peripheral region 11 thereof. As shown in Fig. 1, the airbag 10 has an inflatable body 15 and a pair of uninflatable sections 12 and 13 arranged vertically in a central area of the inflatable body 15 in the inflated state in both a front-rear direction of the vehicle and the vertical direction.

[0033]

The uninflatable sections 12 and 13 are provided to form a region which is thinner than other regions in a vehicle width direction when the airbag 10 is inflated, and are disposed at positions corresponding to the chest Bb and the abdomen Bc, respectively, of the occupant B. The uninflatable sections 12 and 13 are formed by partially bonding the folded airbag material. In addition, each of the uninflatable sections 12 and 13 is substantially oval (elliptical) in side view, and a gas passage 14 for allowing

gas from the inflator 20 to flow frontward is provided between the uninflatable sections 12 and 13. The uninflatable sections 12 and 13 are linearly arranged along the seat back Aa in the vertical direction, and the above-described region extends substantially parallel to the seat back Aa.

[0034]

As shown in Fig. 3, the airbag 10 is first folded such that an upper portion 10a and a lower portion 10b are placed on a vertical center portion 10c, and is then rolled (or accordion-folded) in a front-to-rear direction of the vehicle. The airbag 10 is attached to the seat back Aa in this fashion. When the airbag 10 is folded, first, the upper and lower portions 10a and 10b are entirely folded onto the vertical center portion 10c, and then ends of the upper and lower portions 10a and 10b are folded over, as shown in Fig. 3(b). In addition, the folded airbag 10 is rolled in such a manner that the front end thereof is rolled inward.

[0035]

The inflator 20 is activated and supplies gas to the airbag 10 when a side collision or the like of the vehicle occurs (such a situation is detected by a sensor (not shown)). The inflator 20 is disposed in the airbag 10 and has gas discharge holes 21 and 22 at the bottom end and a lower front position, respectively, of the inflator 20. The gas discharge hole 21 faces downward to discharge the gas downward, and the gas discharge hole 22 faces front to discharge the gas frontward.

[0036]

In the occupant protection device according to the first embodiment that is structured as described above, if a side collision or the like of the vehicle occurs, the inflator 20 is activated when an acceleration detected by

a corresponding sensor (not shown) exceeds a set value. Accordingly, the gas is supplied to the airbag 10 through the gas discharge holes 21 and 22 of the inflator 20, and the airbag 10 is inflated at the side of the occupant B. Thus, the airbag 10 is placed between the vehicle body (door (not shown)) and the body of the occupant B from the shoulder Ba to the lumbar Bd. Therefore, if a part of the vehicle body enters the vehicle cabin, the occupant B is pushed by the airbag 10 toward the center of the vehicle cabin in the vehicle width direction, and accordingly the body of the occupant B from the shoulder Ba to the lumbar Bd is protected.

[0037]

In the occupant protection device according to the first embodiment, the region which is thinner than other regions in the vehicle width direction in the inflated state is formed of the uninflatable sections 12 and 13 in the vertical center portion 10c of the inflatable body 15 of the airbag 10, that is, at a position corresponding to the chest Bb and the abdomen Bc of the occupant B. Accordingly, when the occupant B is pushed by the airbag 10 toward the center of the vehicle cabin in the vehicle width direction, although the shoulder Ba and the lumbar Bd, which come into contact with the upper and lower portions 10a and 10b, respectively, receive a large load, the chest Bb and the abdomen Bc, which come into contact with a substantially central portion of the airbag 10 in the vertical direction, do not receive a large load. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0038]

In addition, in the occupant protection device according to the first embodiment, the above-described region formed of the uninflatable sections 12 and 13 extends substantially parallel to the seat back Aa. Therefore, in the first embodiment, the above-described region can be positioned along the side of the occupant B from the chest Bb to the abdomen Bc. Accordingly, the load applied to the chest Bb and the abdomen Bc of the occupant B when a side collision or the like of the vehicle occurs is reliably reduced.

[0039]

In addition, in the first embodiment, the region of the airbag 10 which is thin in the vehicle width direction in the inflated state is positioned in a central area of the inflatable body 15 of the airbag 10 in the vertical direction, and is substantially oval in side view. Therefore, even when the occupant B sits at different positions in the front-back direction, the above-described region can be positioned along the side of the occupant B from the chest Bb to the abdomen Bc. Accordingly, the load applied to the chest Bb and the abdomen Bc of the occupant B when a side collision or the like of the vehicle occurs is reliably reduced.

[0040]

In addition, in the first embodiment, the region of the airbag 10 which is thin in the vehicle width direction in the inflated state is formed of the uninflatable sections 12 and 13 positioned in the vertical center portion of the inflatable body 15 of the airbag 10, and thus the region is vertically divided into two sections with the gas passage 14 provided between the two sections. Therefore, when a side collision or the like of the vehicle occurs, the gas supplied from the gas discharge hole 22 of the inflator 20 quickly

flows toward the front of the vehicle through the gas passage 14 in the airbag 10. Accordingly, the airbag 10 is quickly inflated in the front-rear direction of the vehicle, and the airbag 10 is quickly placed between the occupant B and the vehicle body.

[0041]

In addition, in the first embodiment, the airbag 10, which is inflated at the side of the occupant B when a side collision or the like of the vehicle occurs, is first folded such that the upper and lower portions 10a and 10b are placed on the vertical center portion 10c, and is then rolled (or accordion-folded) in the front-to-rear direction of the vehicle. Accordingly, when a side collision or the like of the vehicle occurs, the airbag 10 is first inflated in the front-rear direction of the vehicle, and then in the vertical direction. Therefore, although the airbag 10 is attached to the seat back Aa in the folded and rolled state, the airbag 10 is quickly and reliably inflated in the space between the occupant B and the vehicle body when a side collision or the like of the vehicle occurs.

[0042]

In the above-described first embodiment, the region of the airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming the vertically arranged uninflatable sections 12 and 13 in the airbag 10. However, in place of this structure, modifications schematically shown in Figs. 4 and 5, Figs. 6 and 7, Figs. 8 and 9, Figs. 10 and 11, Figs. 12 and 13, and Figs. 14 and 15 may also be applied.

[0043]

Figs. 4 and 5 illustrate a first modification. In the first modification, a region of an airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming a single uninflatable section 12a in the airbag 10. The uninflatable section 12a is formed by partially bonding a folded airbag material, and extends substantially parallel to the seat back Aa. Therefore, in the first modification, the above-described region can be positioned along the side of the occupant B from the chest Bb to the abdomen Bc. Accordingly, the load applied to the chest Bb and the abdomen Bc of the occupant B when a side collision or the like of the vehicle occurs is reliably reduced. In the first modification, an inflator 20 having only a gas discharge hole 21 at the bottom end is used.

[0044]

Figs. 6 and 7 illustrate a second modification. In the second modification, a region of an airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming four uninflatable sections 12b1 to 12b4 in the airbag 10. Each of the uninflatable sections 12b1 to 12b4 is formed by partially bonding a folded airbag material, and extends substantially perpendicular to the seat back Aa.

[0045]

Figs. 8 and 9 illustrate a third modification. In the third modification, a region of an airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to

the chest Bb and the abdomen Bc of the occupant B by forming three uninflatable sections 12c1 to 12c3 in the airbag 10. Each of the uninflatable sections 12c1 to 12c3 is formed by partially bonding a folded airbag material, and extends substantially parallel to the seat back Aa. In the third modification, an inflator 20 having only a gas discharge hole 21 at the bottom end is used.

[0046]

Figs. 10 and 11 illustrate a fourth modification. In the fourth modification, a region of an airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming five uninflatable sections 12d1 to 12d5 in the airbag 10. Each of the uninflatable sections 12d1 to 12d5 is formed by partially bonding a folded airbag material, and is substantially circular in side view.

[0047]

Figs. 12 and 13 illustrate a fifth modification. In the fifth modification, a region of an airbag 10 which is thinner than other regions in the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming an uninflatable section 12e in the airbag 10. The uninflatable section 12e is formed by partially bonding a folded airbag material, and extends in a zigzag fashion in side view. In the fifth modification, an inflator 20 having only a gas discharge hole 21 at the bottom end is used.

[0048]

Figs. 14 and 15 illustrate a sixth modification. In the sixth modification, a region of an airbag 10 which is thinner than other regions in

the vehicle width direction in the inflated state is provided at a position corresponding to the chest Bb and the abdomen Bc of the occupant B by forming an uninflatable section 12f in the airbag 10. The uninflatable section 12f is formed by partially bonding a folded airbag material in such a manner that an inflatable body 15 of the airbag 10 is shaped like a bracket facing front. In the sixth modification, an inflator 20 having gas discharge holes 21 and 22 at the bottom and top ends, respectively, is used.

[0049]

In the above-described embodiment and modifications thereof, the airbag 10 protects the body of the occupant B from the shoulder Ba to the lumbar Bd. However, as in a second embodiment that is schematically shown in Fig. 16, an airbag 110 may include an inflatable body 116 that is integrated with an inflatable body 115 at the bottom of the airbag 110, the inflatable body 116 being inflatable at the side of the thigh Be of the occupant B. In this case, the airbag 110 protects the body of the occupant B from the shoulder Ba to the lumbar Bd and the thigh Be.

[0050]

In addition, in the second embodiment, the airbag 110 has an uninflatable section 117 at a position corresponding to the upper arm Bf of the occupant B, and accordingly an additional region that is thin in the vehicle width direction in the inflated state is provided. The other structures of the second embodiment are the same as those of the first embodiment. Therefore, similar components are denoted by reference numerals obtained by adding 100 to those of the first embodiment, and explanations thereof are thus omitted.

[0051]

In the second embodiment that is structured as described above, effects similar to those of the first embodiment are, of course, obtained. In addition, in the second embodiment, the airbag 110 that is inflated at the side of the occupant B when a side collision or the like of the vehicle occurs includes the inflatable body 116 that is integrated with the inflatable body 115 at the bottom of the airbag 110, the inflatable body 116 being inflated at the side of the thigh Be of the occupant B. Accordingly, the thigh Be of the occupant B is also pushed by the airbag 110 when a side collision or the like of the vehicle occurs. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0052]

In addition, in the second embodiment, the airbag 110 has an additional region that is thin in the vehicle width direction in the inflated state at a position corresponding to the upper arm Bf of the occupant B. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb, the abdomen Bc, and the upper arm Bf.

[0053]

In the above-described first and second embodiments, the region of the airbag 10 or 110 which is thinner than other regions in the vehicle width direction in the inflated state is formed at a position corresponding to the chest Bb and the abdomen Bc of the occupant B. Accordingly, when a side collision or the like of the vehicle occurs, the occupant B is pushed and

moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc. However, structures of a third embodiment schematically shown in Figs. 17 and 18(a), a fourth embodiment schematically shown in Fig. 20, a fifth embodiment schematically shown in Fig. 21, a sixth embodiment schematically shown in Fig. 22, and a seventh embodiment schematically shown in Fig. 23 may also be applied.

[0054]

In the third embodiment shown in Figs. 17 and 18(a), gas-pressure controlling means is provided for setting the inner pressure of a lower portion 210b of an airbag 210 (portion corresponding to the lumbar Bd of the occupant B) higher than that of other portions. Accordingly, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0055]

In addition, in the third embodiment shown in Figs. 17 and 18(a), the gas-pressure controlling means for setting the inner pressure of the lower portion 210b of the airbag 210 higher than that of other portions includes a partition wall 212 formed in the airbag 210 and an inflator 220 having a gas discharge hole 221 only at the bottom end. The partition wall 212 is formed by partially bonding a folded airbag material and extends in the front-rear direction. The rear end of the partition wall 212 is near the inflator 220, and accordingly the partition wall 212 regulates an upward gas flow.

[0056]

Therefore, according to the third embodiment, when a side collision or the like of the vehicle occurs, the lumbar Bd of the occupant B, which comes into contact with the lower portion 210b of the airbag 210, is quickly moved by being pushed with a large gas pressure. Accordingly, when a side collision or the like of the vehicle occurs, the occupant B is quickly pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0057]

In the third embodiment, as shown in Fig. 18(a), the lower portion 210b of the airbag 210 is thicker than other portions in the vehicle width direction in the inflated state. Accordingly, when a side collision or the like of the vehicle occurs, the lumbar Bd of the occupant B, which comes into contact with the lower portion 210b of the airbag 210, is largely moved. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is largely pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0058]

In the above-described third embodiment, the inner pressure of the lower portion 210b of the airbag 210 is set to be higher than that of other portions. Alternately, however, a vertically inverted structure shown in Fig. 18(b) and Fig. 17 in which the corresponding partition wall 212 is shown by an imaginary line may also be applied. In this case, the inner pressure of an upper portion 210a of the airbag 210 is set to be higher than that of other portions.

[0059]

In this case, when a side collision or the like of the vehicle occurs, the shoulder Ba of the occupant B, which comes into contact with the upper portion 210a of the airbag 210, is quickly moved by being pushed with a large gas pressure. Accordingly, when a side collision or the like of the vehicle occurs, the occupant B is quickly pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0060]

In this case, the upper portion 210a of the airbag 210 is thicker than other portions in the vehicle width direction in the inflated state. Accordingly, when a side collision or the like of the vehicle occurs, the shoulder Ba of the occupant B, which comes into contact with the upper portion 210a of the airbag 210, is largely moved. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is largely pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0061]

In the above-described third embodiment, the inner pressure of the lower portion 210b of the airbag 210 is set to be higher than that of other portions. Alternately, however, the structure shown in Fig. 19 may also be applied. In Fig. 19, an airbag 210 includes upper and lower partition walls 212 and 213, and an inflator 220 having gas discharge holes 221 and 222 at the bottom and top ends, respectively, is used. The inner pressures of upper and lower portions 210a and 210b of the airbag 210 are set higher than that of a middle portion 210c.

[0062]

In the fourth embodiment shown in Fig. 20, inflation controlling means is provided for inflating an upper portion 310a and a lower portion 310b of an airbag 310 before other portions (a vertical center portion 310c extending approximately parallel to the seat back Aa). Accordingly, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0063]

In addition, in the fourth embodiment shown in Fig. 20, the inflation controlling means for inflating the upper and lower portions 310a and 310b of the airbag 310 before other portions includes a guide wall 312 formed in the airbag 310 and an inflator 320 having gas discharge holes 321 and 322 at the bottom and top ends, respectively. The guide wall 312 of the airbag 310 sections the upper portion 310a, the lower portion 310b, and the vertical center portion 310c from one other and functions as gas-flow regulating means for causing gas to flow into the upper and lower portions 310a and 310b of the airbag 310 first and then into the vertical center portion 310c. The guide wall 312 is formed in the airbag 310 by sewing the airbag 310.

[0064]

Therefore, in the fourth embodiment, when a side collision or the like of the vehicle occurs, the shoulder Ba and the lumbar Bd of the occupant B, which come into contact with the upper and lower portions 310a and 310b, respectively, of the airbag 310, are pushed before the chest Bb and the abdomen Bc of the occupant B. Therefore, when a side collision or the like of the vehicle occurs, the occupant B is pushed and moved toward the

center of the vehicle cabin in the vehicle width direction without receiving a large load at the chest Bb and the abdomen Bc.

[0065]

In addition, in the fourth embodiment, the vertical center portion 310c, which is inflated after the upper and lower portions 310a and 310b of the airbag 310, extends substantially parallel to the seat back Aa. Therefore, this portion can be positioned along the side of the occupant B from the chest Bb to the abdomen Bc. Accordingly, the load applied to the chest Bb and the abdomen Bc of the occupant B when a side collision or the like of the vehicle occurs is reliably reduced.

[0066]

In addition, in the fourth embodiment, the inflation controlling means for inflating the upper and lower portions 310a and 310b of the airbag 310 before other portions is the gas-flow regulating means for causing the gas to flow into the upper and lower portions 310a and 310b of the airbag 310 first and then into the vertical center portion 310c, and the gas-flow regulating means includes the guide wall 312 formed in the airbag 310 by sewing the airbag 310. Thus, the inflation controlling means is easily formed.

[0067]

In the above-described fourth embodiment, the upper and lower portions 310a and 310b of the airbag 310 are inflated before the vertical center portion 310c. Alternatively, however, one of the upper and lower portions 310a and 310b of the airbag 310 may be inflated before the vertical center portion 310c.

[0068]

In the fifth embodiment shown in Fig. 21, an airbag 410 is provided

with shape adjusting means for adjusting the shape of the airbag 410 so that the side of the airbag 410 facing the occupant B extends along the side of the occupant B. More specifically, a plurality of straps 412a, 412b, and 412c extend in the vehicle width direction in the airbag 410. Each of the straps 412a, 412b, and 412c is fixed to the airbag 410 at both ends thereof.

[0069]

Therefore, in the fifth embodiment, the occupant B is prevented from receiving a local load from the airbag 410. Accordingly, not only the load applied to the shoulder Ba and the lumbar Bd of the occupant B when a side collision or the like of the vehicle occurs but also the load applied to the chest Bb and the abdomen Bc of the occupant B is reliably reduced. In addition, in the fifth embodiment, since the shape adjusting means includes a plurality of straps 412a, 412b, and 412c, the shape adjusting means is easily formed.

[0070]

In the sixth embodiment shown in Fig. 22, an airbag 510 is provided in a seat cushion Ab of the seat A. The airbag 510 moves the occupant B upward in the inflated state. Therefore, in the sixth embodiment, when a side collision or the like of the vehicle occurs, the chest Bb of the occupant B is prevented from encountering a projecting portion on the vehicle, for example, an armrest (not shown) provided on the door. Thus, the load applied to the chest Bb of the occupant B is reduced.

[0071]

In the seventh embodiment shown in Fig. 23, an airbag 610 is provided in the seat back Aa. The airbag 610 includes a first inflatable body 610a that inflates between the seat back Aa and the back of the

occupant B along the edge adjacent to the door and a second inflatable body 610b that inflates between the door (not shown) and the side of the occupant B adjacent to the door. The airbag 610 moves the chest Bb of the occupant B diagonally to the front away from the door.

[0072]

Accordingly, in the seventh embodiment, when a side collision or the like of the vehicle occurs, the first and second inflatable bodies 610a and 610b of the airbag 610 reliably move the chest Bb of the occupant B diagonally to the front away from the door. Thus, the chest Bb of the occupant B is reliably prevented from encountering the armrest provided on the vehicle door. In addition, the second inflatable body 610b of the airbag 610 serves to reduce the load applied to the occupant B from the door.

[Brief Description of the Drawings]

Fig. 1 is a side view schematically illustrating an occupant protection device according to a first embodiment of the present invention.

Fig. 2 is a sectional view of Fig. 1 taken along line S1-S1.

Fig. 3 is a diagram illustrating the manner in which the airbag shown in Fig. 1 is folded.

Fig. 4 is a side view schematically illustrating a first modification of the first embodiment.

Fig. 5 is a sectional view of Fig. 4 taken along line S2-S2.

Fig. 6 is a side view schematically illustrating a second modification of the first embodiment.

Fig. 7 is a sectional view of Fig. 6 taken along line S3-S3.

Fig. 8 is a side view schematically illustrating a third modification of the first embodiment.

Fig. 9 is a sectional view of Fig. 8 taken along line S4-S4.

Fig. 10 is a side view schematically illustrating a fourth modification of the first embodiment.

Fig. 11 is a sectional view of Fig. 10 taken along line S5-S5.

Fig. 12 is a side view schematically illustrating a fifth modification of the first embodiment.

Fig. 13 is a sectional view of Fig. 12 taken along line S6-S6.

Fig. 14 is a side view schematically illustrating a sixth modification of the first embodiment.

Fig. 15 is a sectional view of Fig. 14 taken along line S7-S7.

Fig. 16 is a side view schematically illustrating an occupant protection device according to a second embodiment of the present invention.

Fig. 17 is a side view schematically illustrating an occupant protection device according to a third embodiment of the present invention.

Fig. 18 is a sectional view of Fig. 17 taken along line S8-S8.

Fig. 19 is a side view schematically illustrating a modification of the third embodiment.

Fig. 20 is a side view schematically illustrating an occupant protection device according to a fourth embodiment of the present invention.

Fig. 21 is a horizontally sectioned plan view schematically illustrating the major part of an occupant protection device according to a fifth embodiment of the present invention.

Fig. 22 is a vertically sectioned plan view schematically illustrating the major part of an occupant protection device according to a sixth embodiment of the present invention.

Fig. 23 is a horizontally sectioned plan view schematically illustrating the major part of an occupant protection device according to a seventh embodiment of the present invention.

[Document name] Abstract

[Abstract]

[Problem]

to prevent a chest and abdomen of an occupant from receiving a large load when a side collision or the like of a vehicle occurs

[Means to solve]

An occupant protection device includes an airbag 10 that is inflated with gas from an inflator 20 at a side of an occupant B to protect the body of the occupant B from the shoulder Ba to the lumbar Bd, the airbag 10 having substantially the same vertical dimension as that of a seat back Aa. In this occupant protection device, uninflatable sections 12 and 13 are formed in a vertical center portion 10c of the airbag 10, that is, at a position corresponding to the chest Bb and the abdomen Bc of the occupant B. Accordingly, a region which is thinner than an upper portion 10a and a lower portion 10b of the airbag 10 in a vehicle width direction when the airbag 10 is inflated and that extends substantially parallel to the seat back Aa is formed substantially at the center of the airbag 10.

[Elected view] Figure 1

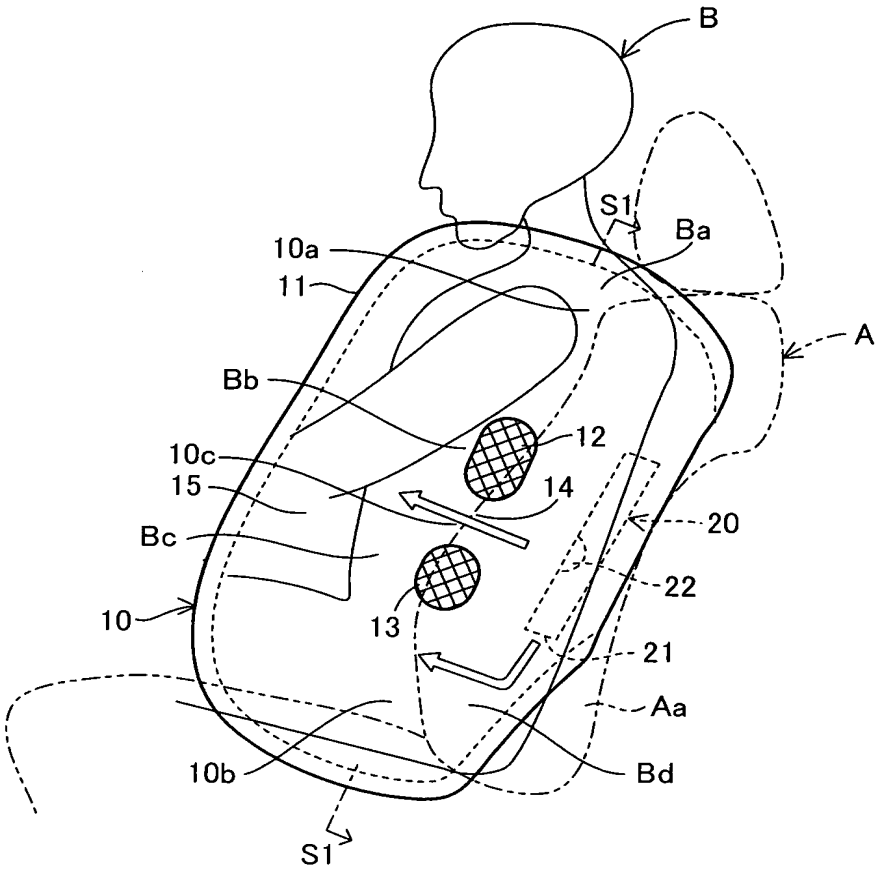


FIG.1

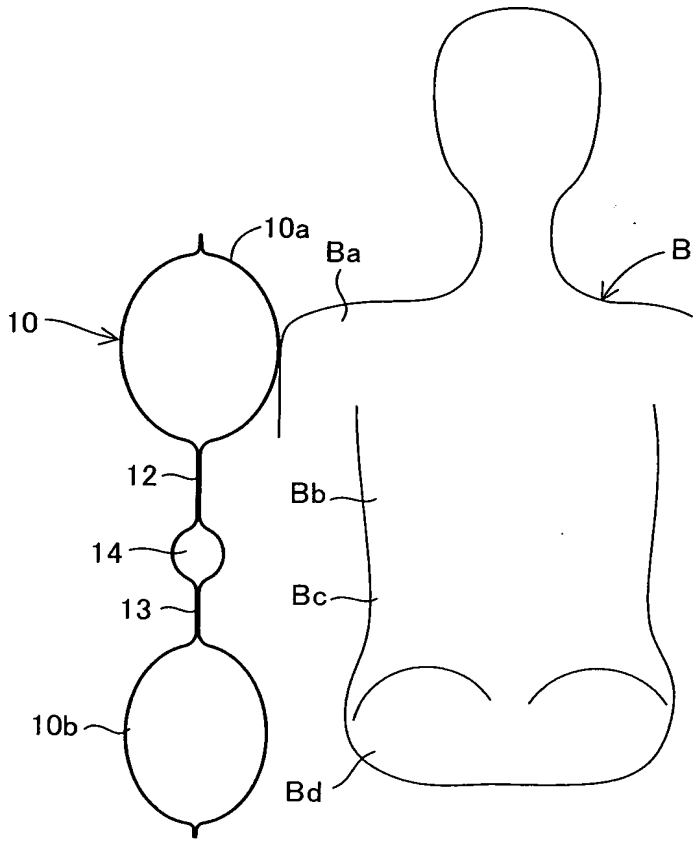
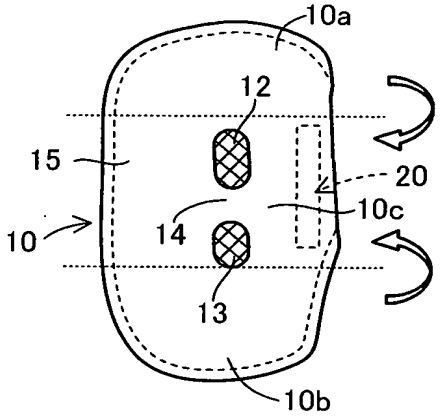
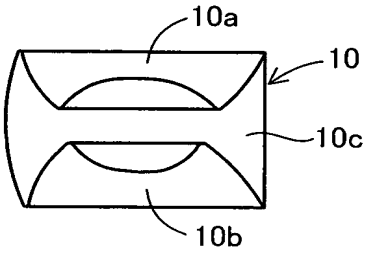


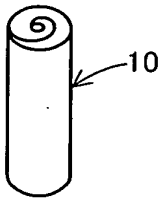
FIG.2



(a)



(b)



(c)

FIG.3

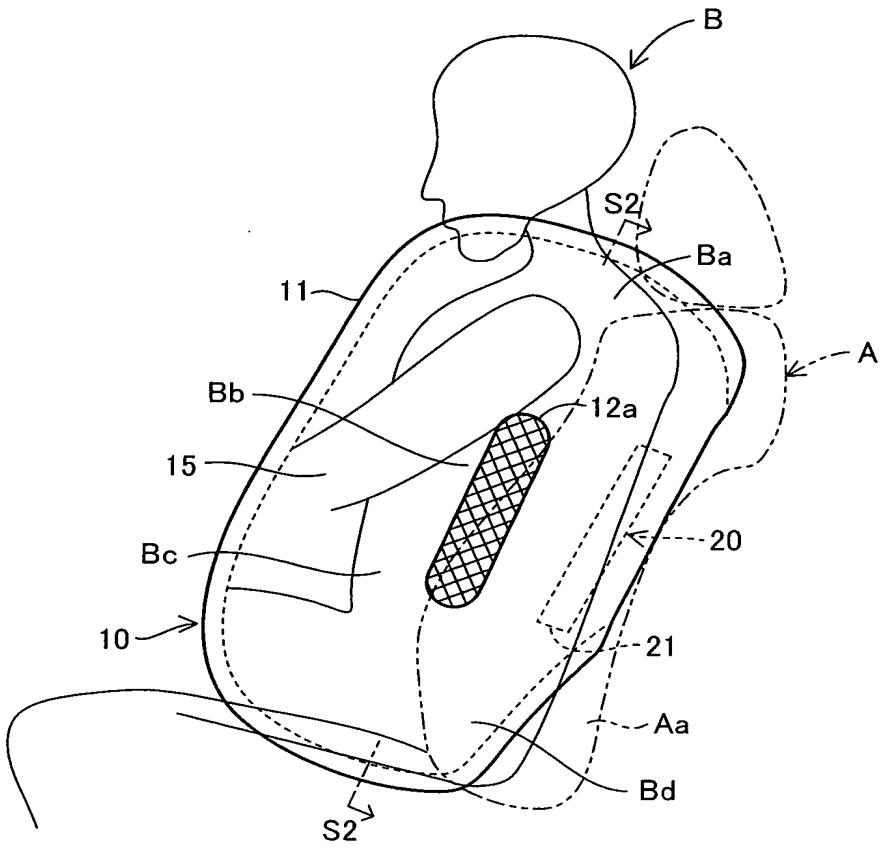


FIG.4

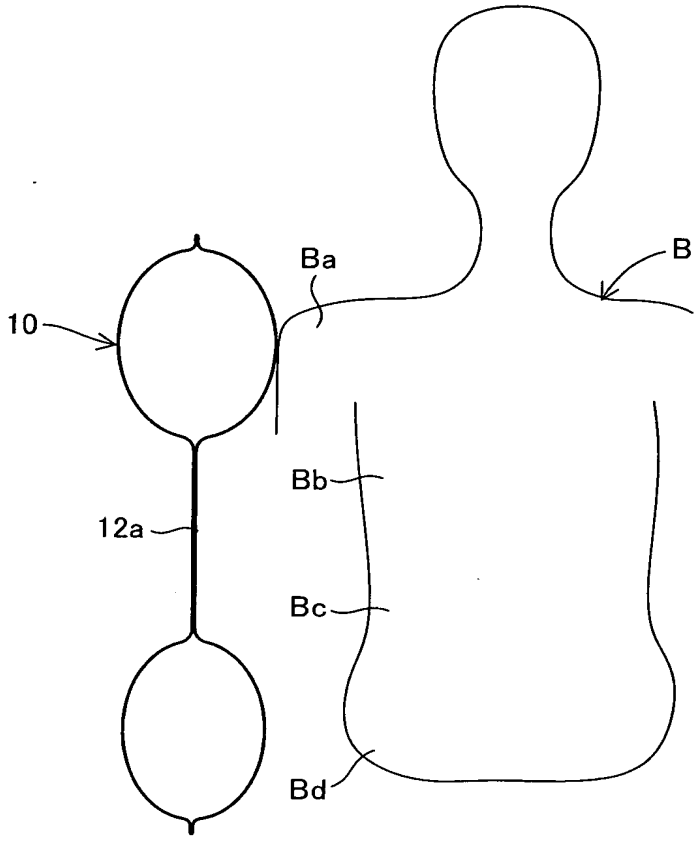


FIG.5

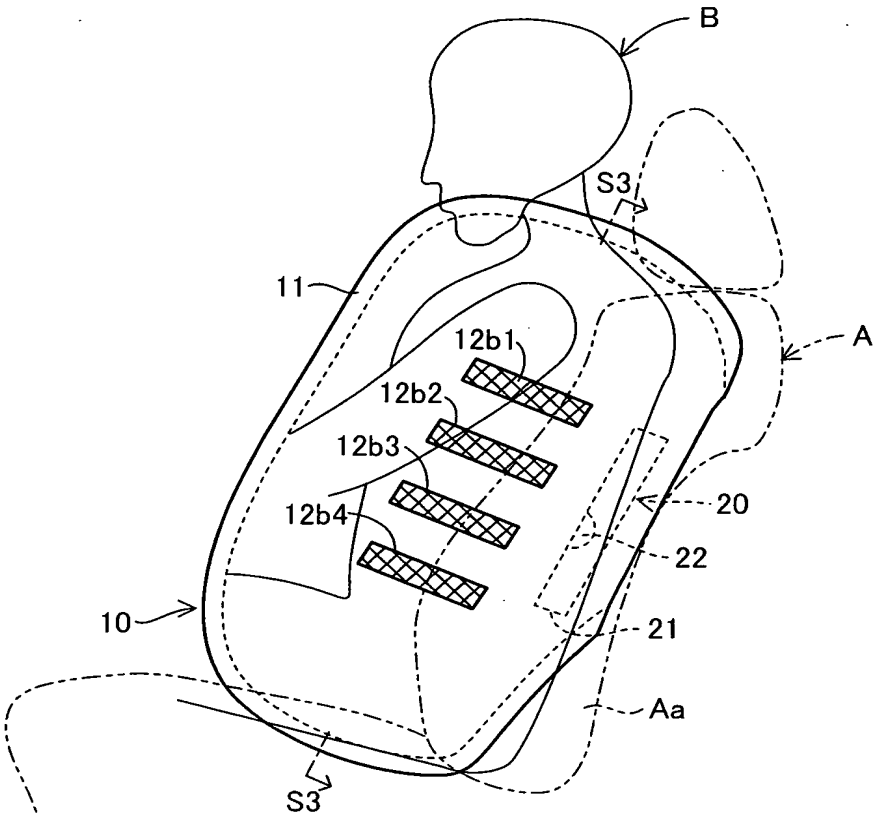

B
S3
11
A
12b1
12b2
12b3
12b4
20
22
10
21
Aa
S3

FIG.6

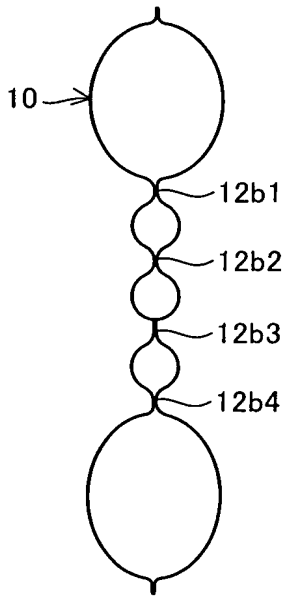

10
12b1
12b2
12b3
12b4

FIG.7

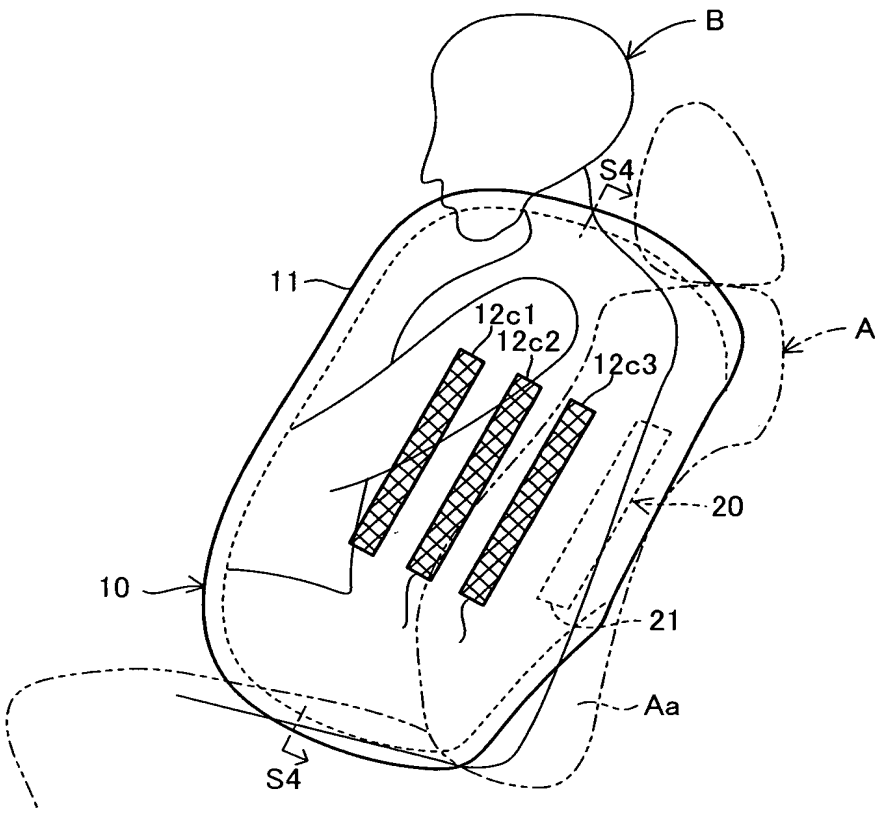


FIG.8

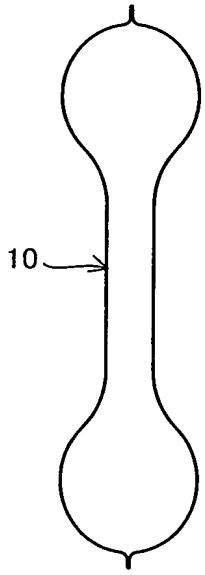


FIG.9

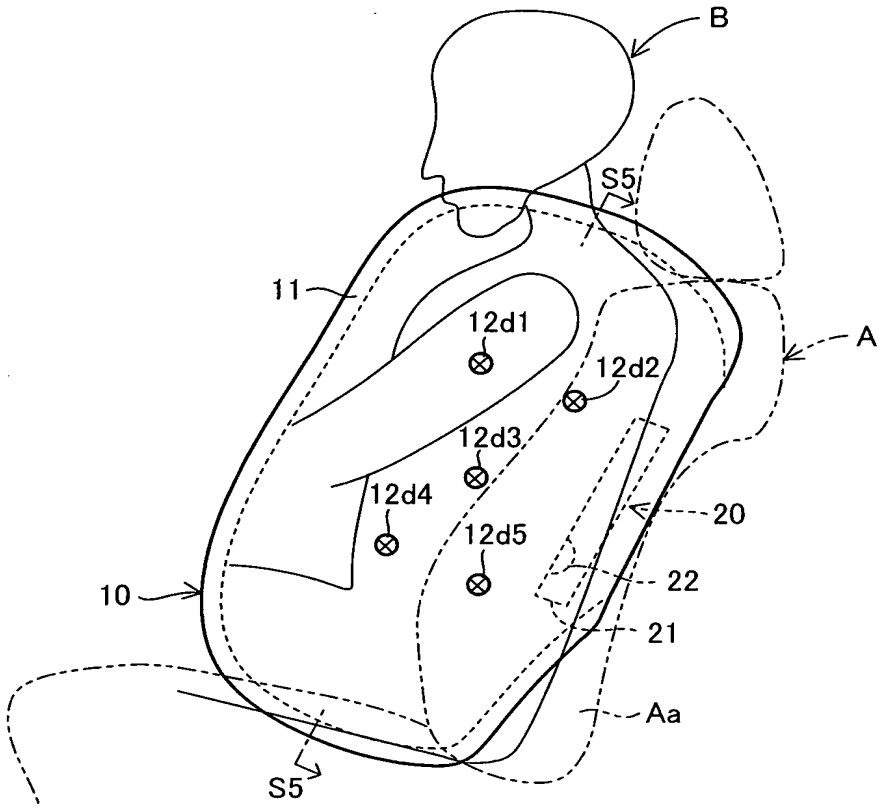


FIG.10

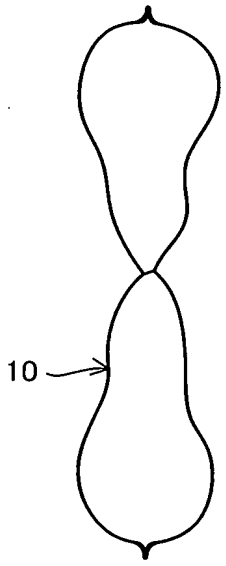


FIG.11

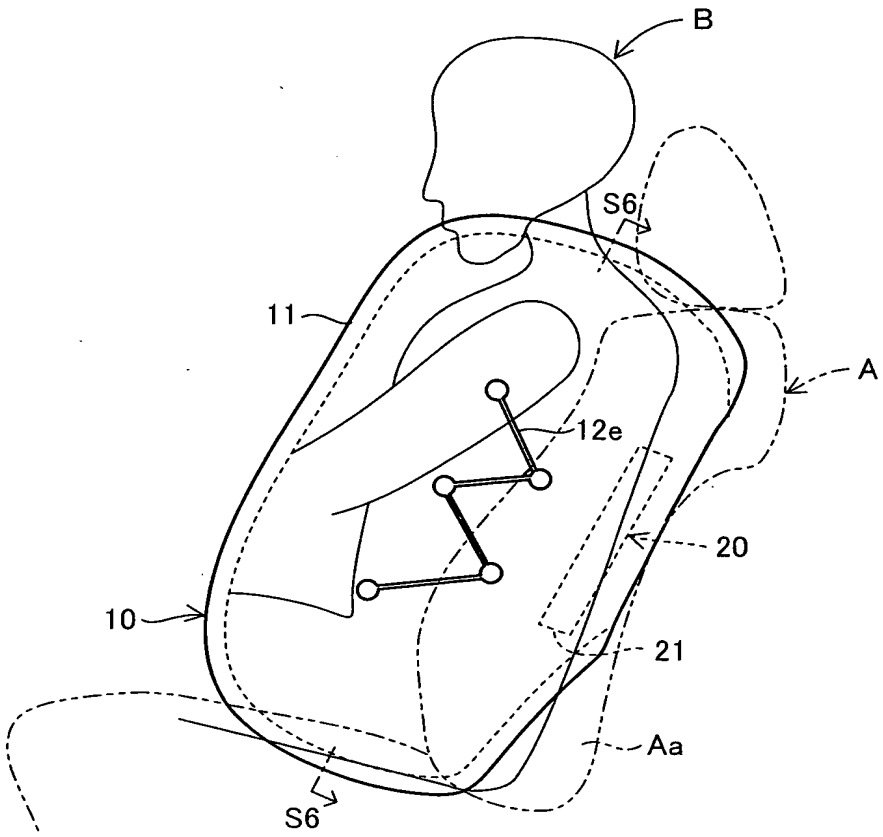


FIG.12

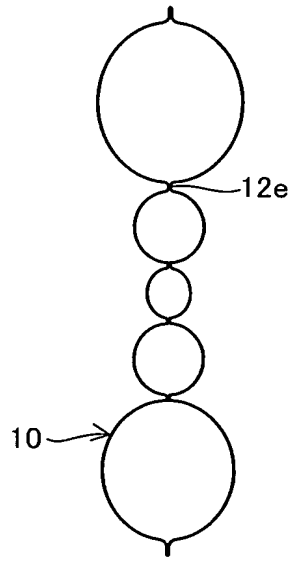


FIG.13

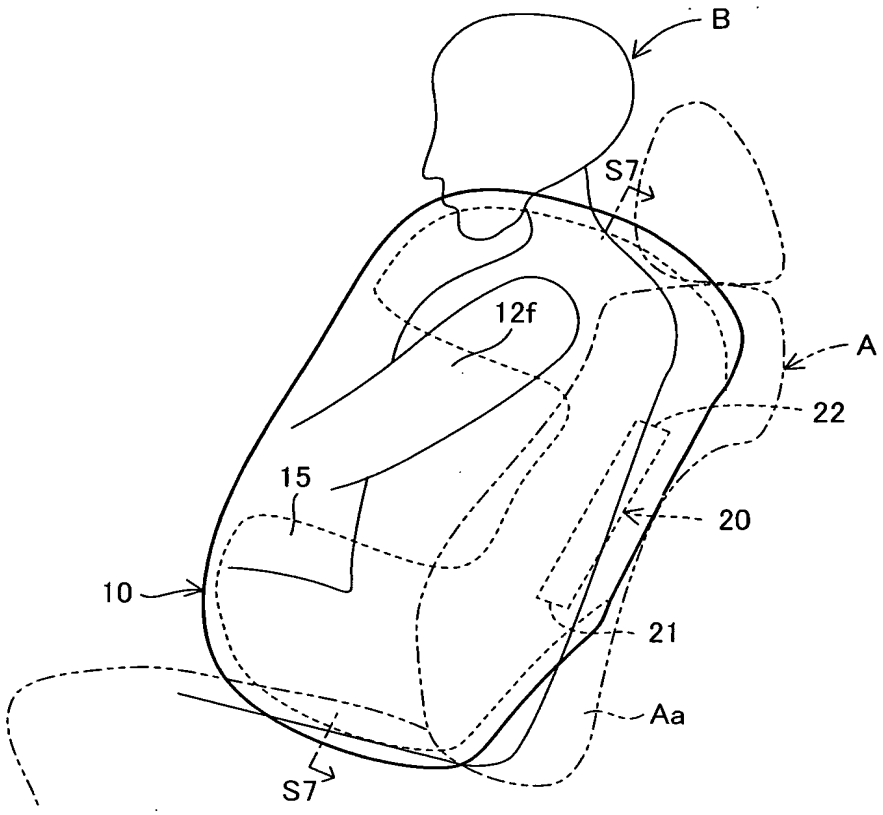


FIG.14

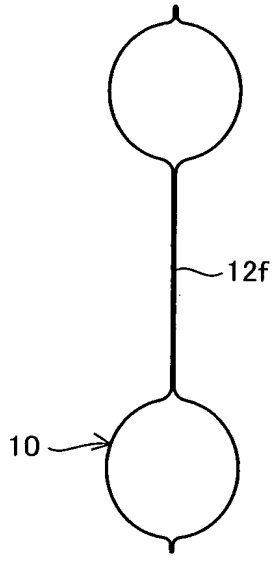


FIG.15

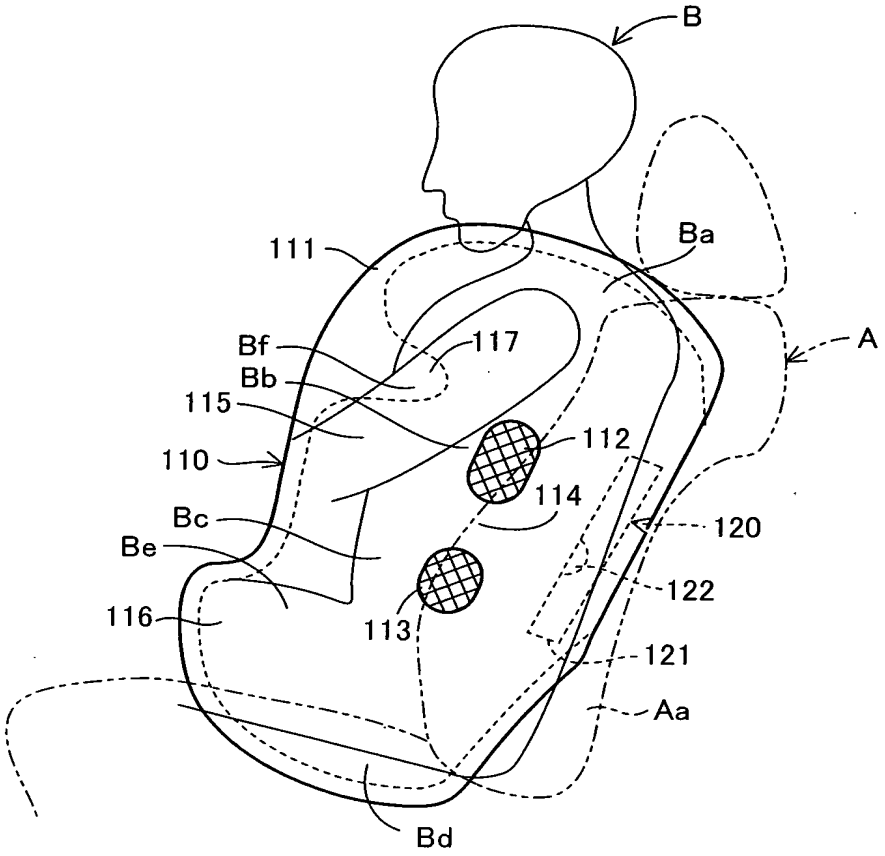


FIG.16

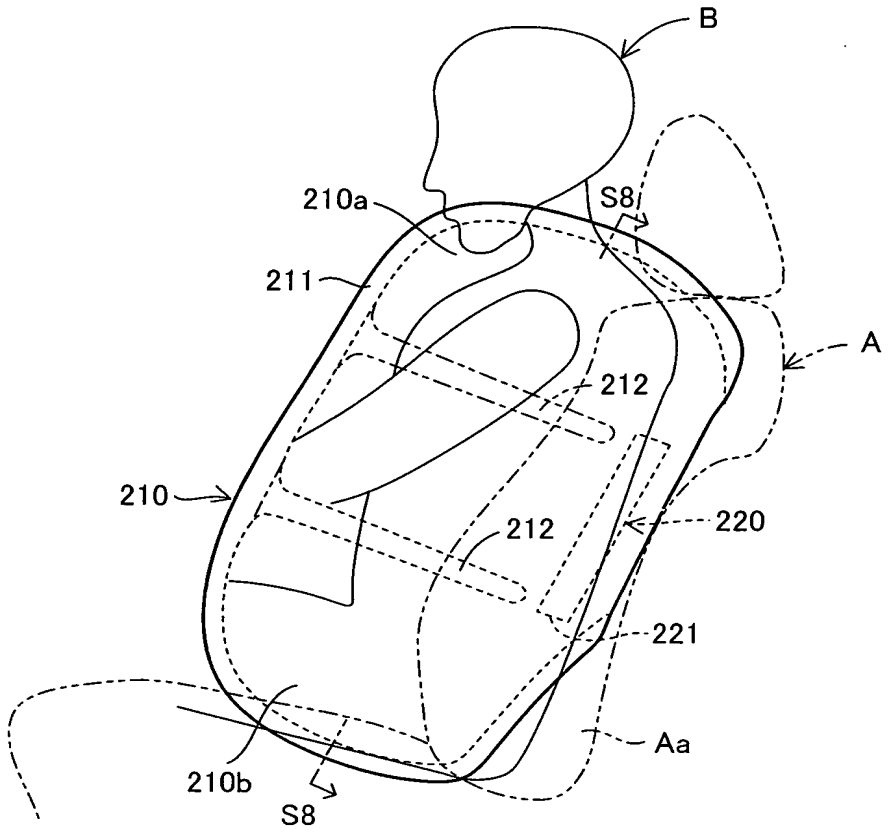

B
210a
S8
211
A
212
210
212
220
221
Aa
210b
S8

FIG.17

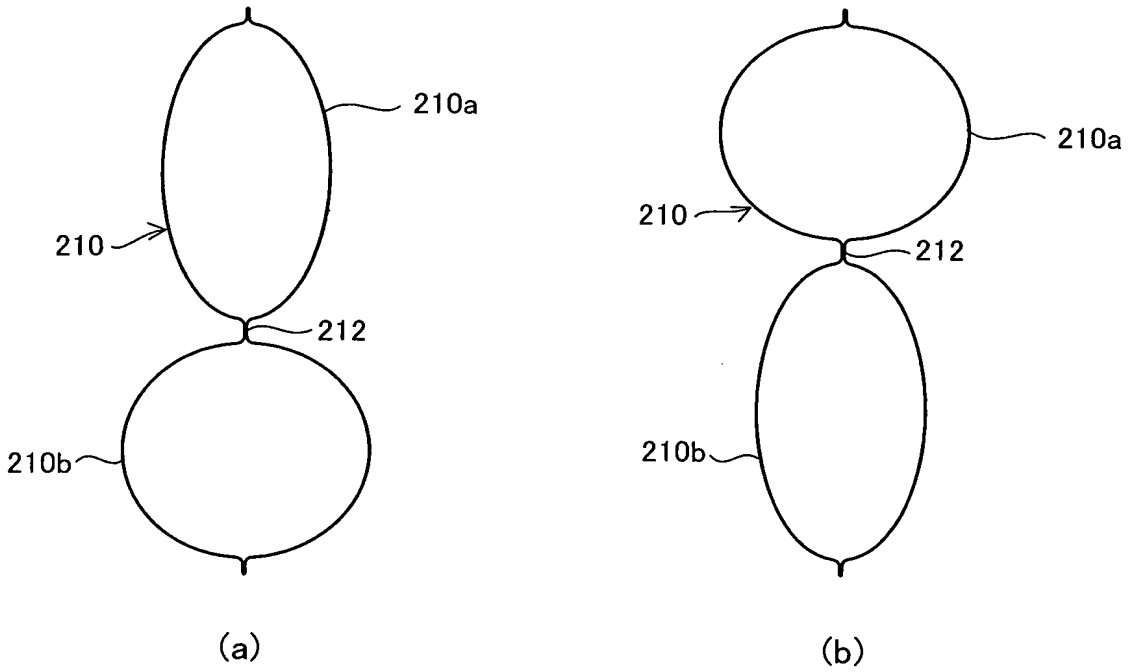

210a
210
212
210b
(a)
210a
210
212
210b
(b)

FIG.18

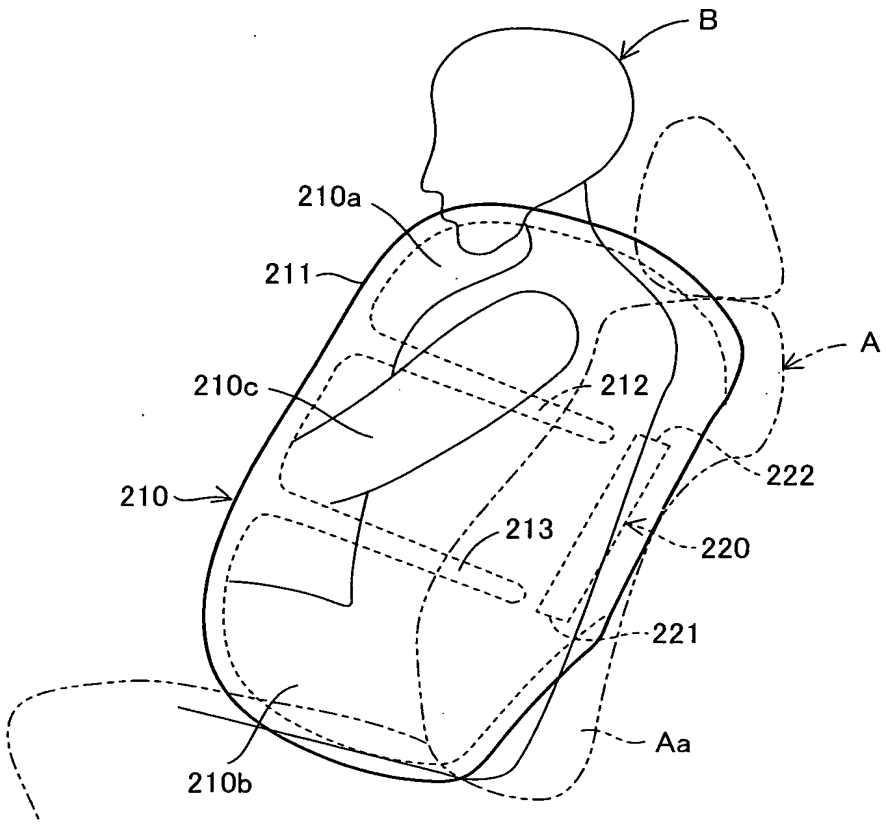


FIG.19

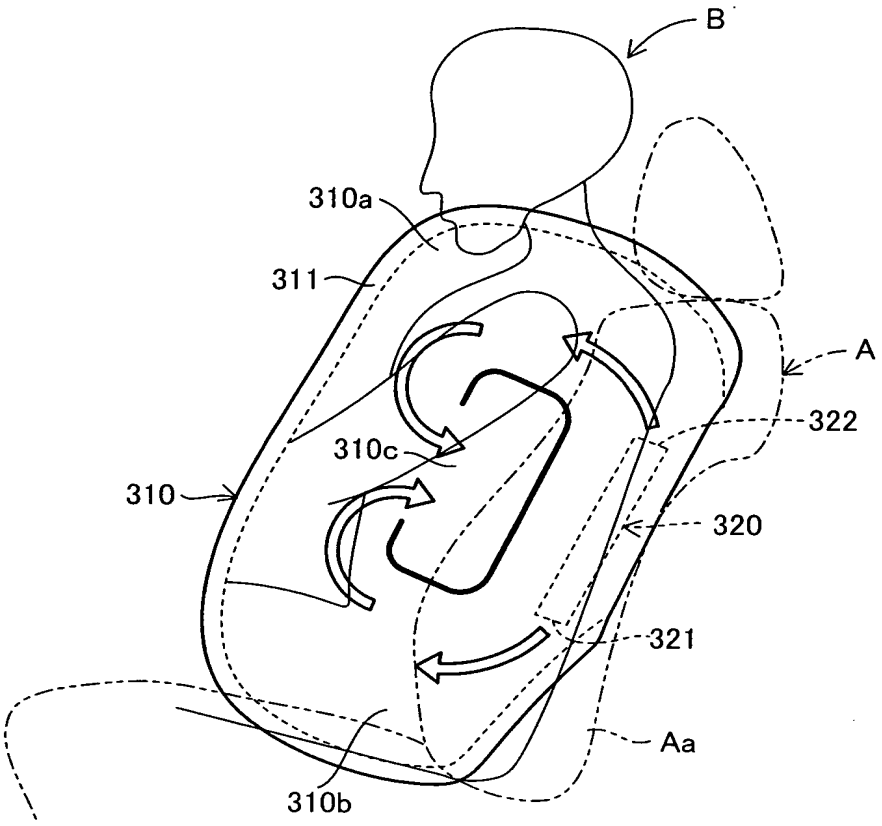


FIG.20

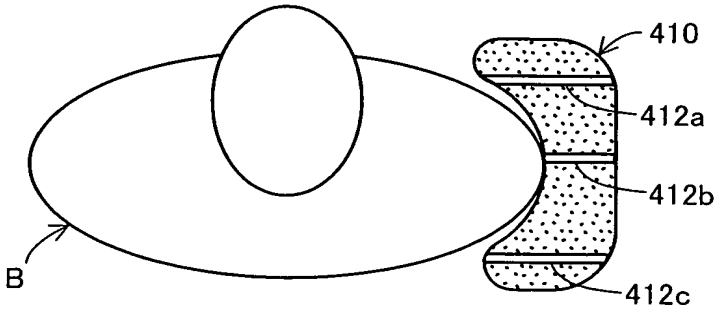


FIG.21

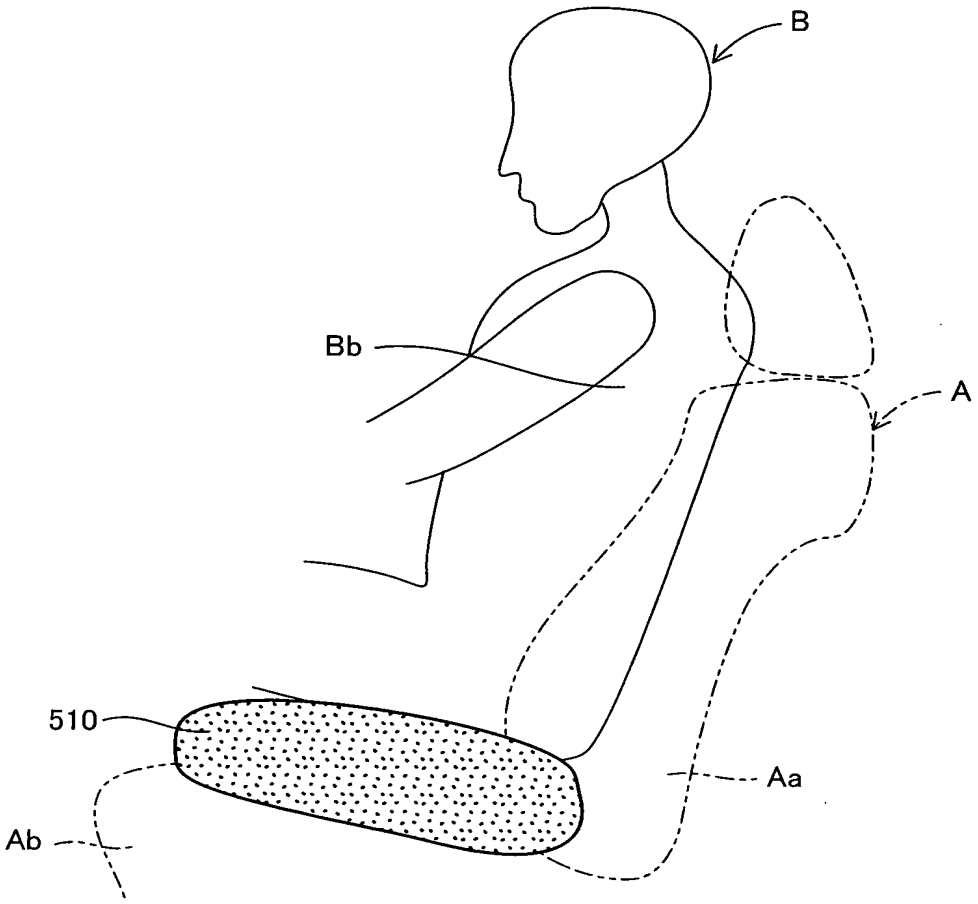


FIG.22

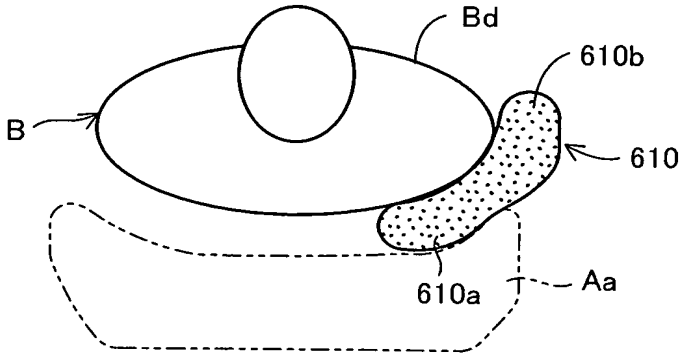


FIG.23